ORIGINAL ARTICLE

DEXMEDETOMIDINE PROLONGS THE EFFECT OF 0.5% ISOBARIC LEVOBUPIVACAINE IN AXILLARY BRACHIAL PLEXUS BLOCK

Karthik Anandh V¹, J. P. S. Bhupal², Tejinderpal Kaur Grewal³, Tripat Kaur Bindra⁴, Rajan Verma⁵

HOW TO CITE THIS ARTICLE:

Karthik Anandh V, J. P. S. Bhupal, Tejinderpal Kaur Grewal, Tripat Kaur Bindra, Rajan Verma. "Dexmedetomidine Prolongs the Effect of 0.5% Isobaric Levobupivacaine in Axillary Brachial Plexus Block". Journal of Evolution of Medical and Dental Sciences 2015; Vol. 4, Issue 06, January 19; Page: 1015-1022, DOI: 10.14260/jemds/2015/142

ABSTRACT: INTRODUCTION: Upper limb surgeries are mostly performed under peripheral blocks; the brachial plexus block. Peripheral nerve blocks not only provide intraoperative anaesthesia but also prolong analgesia in the post-operative period. Although studies have described the effects of dexmedetomidine on neuraxial and peripheral nerve blocks, till date, there are limited number of studies available on the effect of adding dexmedetomidine to levobupivacaine for an axillary brachial plexus block. **OBJECTIVE:** In this study, we aimed to investigate the effects of adding 1 µg/kg of dexmedetomidine to levobupivacaine for an axillary brachial plexus block to assess the onset and duration of sensory and motor block along with duration of analgesia in the postoperative period. **METHODS:** Hundred patients with American Society of Anesthesiologists (ASA) physical status I/II, scheduled to undergo forearm and hand surgeries, were enrolled for the prospective randomized, double blind placebo controlled study. Patients were divided into two equal groups. Group I [Control Group]: 39 ml of 0.5% isobaric levobupivacaine + 1 ml of isotonic saline. Group II [Study Group]: 39 ml of 0.5% isobaric levobupivacaine + 1 ml of dexmedetomidine (1 µg/kg) solution. **RESULTS:** The results showed that the onset of sensory and motor block are significantly shorter in group II (study group) ($p < 0.05$) while the duration of blocks were significantly longer in group II ($p < 0.05$) along with better postoperative analgesia. None of the patients had bradycardia, hypotension or any other side effects in either of the groups. **CONCLUSION:** Addition of dexmedetomidine (1 µg/kg) to 0.5% isobaric levobupivacaine shortens the onset time of sensory and motor block significantly, increases the duration of sensory and motor block and prolong the duration of postoperative analgesia without any side effects.

KEYWORDS: axillary brachial plexus block, levobupivacaine, dexmedetomidine.

INTRODUCTION: The axillary approach to brachial plexus blockade provides satisfactory anaesthesia for elbow, forearm and hand surgery. In addition, the axillary approach remains the safest of the four main options, it neither risk blockade of the phrenic nerve, nor does it have the potential to cause pneumothorax, thus making it an ideal option for day care surgery.⁽¹⁾

Levobupivacaine is the S (-)-enantiomer of racemic bupivacaine; it has less cardio- toxicity compared with bupivacaine, however its pharmacology and duration of anaesthesia are similar to those of bupivacaine.⁽²⁾ Hence it is increasingly being used considering its safety profile.

Adjuvants are commonly used in peripheral nerve blocks for faster onset and longer duration of anaesthesia. Alpha-2 adrenergic receptor agonists have been the focus of interest for their sedative, analgesic, perioperative sympatholytic with cardiovascular safety profiles and reduced anaesthetic requirements. Furthermore, various methods of administration, such as epidural, intrathecal and peripheral injections, have been tried either alone or in combination with another drug to prolong and intensify the anaesthesia.⁽³⁻⁵⁾

ORIGINAL ARTICLE

Dexmedetomidine is highly selective α_2 adrenergic agonist than partial α_2 adrenergic agonist clonidine (ratios of $\alpha_2:\alpha_1$ activity, 1620:1 for dexmedetomidine, 220:1 for clonidine). Few studies have evaluated the effects of dexmedetomidine on peripheral nerve blocks.⁽⁶⁻⁹⁾ and dexmedetomidine was reported to be safe and effective in these studies. In a study of comparing the effect of addition of 100 μg of dexmedetomidine to levobupivacaine, dexmedetomidine resulted in shortening of the onset time of block, along with prolonged duration of the sensory and motor block with increased duration of postoperative analgesia. However there was increased incidence of bradycardia.⁽¹⁰⁾

Decreasing the dose of dexmedetomidine may help to reduce side effects such as bradycardia and hypotension. So we conducted a study to evaluate the effects of addition of 1 $\mu\text{g}/\text{kg}$ of dexmedetomidine to levobupivacaine for an axillary brachial plexus block. The primary outcome of our study was the onset and duration of sensory and motor block and the secondary outcome was postoperative analgesia.

MATERIALS AND METHODS: In this prospective, double-blind, randomized placebo controlled trial, 100 patients of age between 20-60 years with American Society of Anaesthesiologists (ASA) physical status I/II scheduled to undergo forearm and hand surgeries under axillary brachial plexus block were enrolled for the study. The patients were randomly divided into 2 equal groups: Group I (n = 50): 39 ml of 0.5% isobaric levobupivacaine with 1 ml of isotonic sodium chloride. Group II (n= 50): 39 ml of 0.5% isobaric levobupivacaine and 1 ml of dexmedetomidine (1 $\mu\text{g}/\text{kg}$) with isotonic sodium chloride.

A written informed consent was obtained from each patient after explaining the technique prior to inclusion in this study in their own vernacular language. Exclusion criteria were patient's refusal, infection at the site of block, history of cardiac, respiratory, renal or hepatic failure, coagulation disorders, allergy to amide local anaesthetics, neurological disorders, pregnant women.

The baseline values of arterial blood pressure (BP), heart rate (HR), and peripheral oxygen saturation (SpO_2) were recorded in the operating room before the block, In the contralateral arm a 20-gauge intravenous catheter was inserted.

Under aseptic precautions the axillary block was performed with the patient in the supine position with the upper arm in 90° abduction and the elbow in 110° flexion. The total volume of solution injected was adjusted to 40 ml by adding normal saline. The pulse of axillary artery was identified as high in the axilla proximally as possible. 15 ml of the solution was injected superior to the artery and 15 ml of the solution was injected inferior to the artery. The insertion of the biceps tendon was identified and the site was marked 1-2 cm laterally; a field block was performed by injecting 10 ml of the solution. The nerves are identified by elicitation of paresthesia technique. During injection, negative aspiration was performed every 3.0 to 4.0 ml to avoid intravascular injection. If there was any blockade failure in a nerve distribution region, the patients were excluded from the study. All axillary brachial plexus blocks were performed by the same anaesthesiologist who was blinded to the study groups.

Sensory and motor blocks of the median, radial, ulnar, and musculocutaneous nerves and HR, BP, and SpO_2 values were recorded 5, 10, 15, 20, 25, 30, 45, 60, 75, 90 and 120 minutes after the block and 30 minutes and 3, 6, and 12 hours after the end of the surgery.

ORIGINAL ARTICLE

Sensory block of each nerve was assessed by a pinprick test using a 3-point scale:

- 0=Normal sensation
- 1=Loss of sensation of pinprick (analgesia)
- 2=Loss of sensation of touch (anaesthesia)

Motor block was evaluated by thumb adduction (ulnar nerve), thumb abduction (radial nerve), flexion of the elbow and pronation of forearm (musculocutaneous), and thumb opposition (median nerve). Motor block evaluation was performed using a modification of the Lovett rating scale from 6 (normal muscular force) to 0 (complete paralysis).

Lovett rating Scale:

- 6 –Normal muscular force
- 5 - Slightly reduced muscular force
- 4 - Pronounced reduction of muscular force
- 3 - Slightly impaired mobility
- 2 - Pronounced mobility impairment
- 1 - Almost complete paralysis
- 0 - Complete paralysis.

The onset time of the sensory and motor block was defined as the time between the end of the local anaesthetic injection and complete loss of sensation and complete paralysis respectively. The duration of the sensory block was considered as the time interval between complete sensory block and the return of normal sensation, and the duration of motor block was defined as the time interval between the complete paralysis and complete recovery of motor function.

The time to first analgesic use and total need for analgesics were recorded during the first postoperative 12 hours. Postoperative pain levels were evaluated by a 10-cm visual analog scale (VAS) from 0 (no pain) to 10 (severe pain).

Hypotension (a 20% decrease from the baseline value), bradycardia (HR < 50 beats/min), hypoxemia (SpO₂ < 90%), and nausea and vomiting occurrences were also recorded. If there were hypotension, bradycardia, and hypoxemia, we planned to administer ephedrine 10 mg intravenously, atropine 1 mg intravenously, and 4 to 5 L/hour O₂ inhalation therapy, respectively. If VAS values were > 4, the patient was given diclofenac 75 mg intramuscularly.

ORIGINAL ARTICLE

Sample size was determined on the basis of a pilot study in which the reduction in post-operative pain score (visual analogue scale) was measured as 30%. We calculated a minimum sample size of 40 patients was required in each group, assuming a type 1 error (two-tailed) of 0.05 and a margin of error of 10%. Therefore, the final sample selected was n=50 in Group I and n=50 in Group II.

Descriptive statistics was done for all data and suitable statistical tests of comparison were done. Continuous variables were analyzed with the ANOVA and categorical variables were analyzed with the Chi-Square Test and Fisher Exact Test. Statistical significance was taken as $P < 0.05$.

RESULTS: The basic demographic characteristics were comparable in both the groups. (Table I)

	Group I (n = 50) mean(SD)	Group II (n = 50) mean(SD)
Age, years	32.48(11.10)	37.36(12.41)
Sex (male/female)	37/13	43/7
Weight, kg	65.56(6.39)	66.42(5.34)
Duration of Surgery, min	63.6(7.14)	68(5.43)
TABLE I: PATIENT AND SURGICAL CHARACTERISTICS		

Group I-Bupivacaine group, Group II-Bupivacaine + dexmedetomidine group

The time of onset of sensory blockade was 10.16 minutes (mean) in Group I and 7.88 minutes (mean) in Group II while the onset time of motor block was 15.04 minutes (mean) in Group I and 13.16 minutes in Group II (Table II).

The duration of sensory blockade was 656.1 minutes (mean) in Group I and 918.8 minutes (mean) in Group II while the duration of motor blockade was 538.7 minutes (mean) in Group I and 799.9 minutes (mean) in Group II. The 12-hour postoperative VAS was also lower in Group II (Table II).

	Group I (n = 50) mean (SD)	Group II (n = 50) mean (SD)
Sensory block onset time, min	10.16 (1.13)	7.88 (0.87)
Motor block onset time, min	15.04 (0.85)	13.16 (0.88)
Duration of sensory block, min	656.1 (8.58)	918.8 (10.12)
Duration of motor block, min	538.7 (7.68)	799.9 (12.59)
Total analgesic requirement	13	0
TABLE II: BLOCK CHARACTERISTICS		

Intraoperative heart rate, systolic and diastolic blood pressure were significantly lower in Group II ($p < 0.01$) (Figure 1, 2 and 3). But, no patient experienced an episode of hypotension, bradycardia, or hypoxemia or any other side effects.

ORIGINAL ARTICLE

Fig. 1: Intraoperative heart rate values showing decrease in heart rate in Group II compared with Group I.

Fig. 2: Intraoperative systolic blood pressure values showing decrease in SBP in Group II compared with Group I.

Fig. 3: Intraoperative diastolic blood pressure values showing decrease in DBP in Group II compared with Group I.

DISCUSSION: Addition of dexmedetomidine (1µg/kg) to isobaric levobupivacaine shortens the onset time of sensory and motor block, increases the duration of sensory and motor block along with prolonged duration of postoperative analgesia. This dose do have an effect on systolic, diastolic blood pressure and heart rate of the patients but did not produce significant bradycardia or hypotension in our study. These findings are in accord with those of previous trials (11).

Local anaesthetics are the commonest agents used for peripheral nerve blocks but they are associated with short duration of action and thus requiring analgesic intervention in the early post-operative period. To enhance and prolong the effect of local anaesthetics and reduce their side effects many adjuvants have been used in combination with local anaesthetics.

Alpha₂ agonists are the most commonly used adjuvants. The mechanism by which α₂ adrenergic receptor agonists produce analgesia and sedation is not fully understood but is likely to be multifactorial. Peripherally, α₂ agonists produce analgesia by reducing release of norepinephrine and causing α₂ receptor-independent inhibitory effects on nerve fiber action potentials. Centrally, α₂ agonists produce analgesia and sedation by inhibition of substance P release in the nociceptive pathway at the level of the dorsal root neuron and by activation of α₂ adrenoceptors in the locus coeruleus.(12,13)

Clonidine is one of the most commonly used drug for prolongation of duration of axillary brachial plexus block.(14-16) Few studies showed contradictory results (17-19). Duma et al studied the effects of adding clonidine to levobupivacaine and ropivacaine and observed no significant difference in duration between groups.(20)

Erlacher et al(18) also did not find an advantage in the quality and duration of the block in their axillary block that was formed with the addition of clonidine to ropivacaine. Clonidine may lead to side effects such as bradycardia, hypotension and respiratory depression.

Several studies have found dexmedetomidine to be safe and effective in various neuraxial and regional anesthetics in humans, including intrathecal and IV regional anaesthesia.(6-8)

ORIGINAL ARTICLE

In a study that compared the effects of adding either clonidine or dexmedetomidine to lidocaine during a Bier block, it was found that adding dexmedetomidine improved the quality of anaesthesia and analgesia more than the addition of clonidine.⁽⁹⁾

In a study by Esmaoglu et al⁽¹⁰⁾ addition of 100 µg of dexmedetomidine led to side effects such as bradycardia and hypotension, along with its effects such as sedation and anxiolysis.

Kenan Kaygusuz et al⁽¹¹⁾ conducted a study to investigate the effects of adding dexmedetomidine to levobupivacaine for an axillary brachial plexus block in 64 patients. They concluded that adding dexmedetomidine for an axillary brachial plexus block at a dose of 1 µg/kg improves block quality by shortening the sensory block onset time, increasing the sensory and motor block duration, and increasing the interval to the first analgesic use with no side effects.

We took sample size of 100 and observed that addition of dexmedetomidine of 1µg/kg to 0.5% levobupivacaine provides safe and better anaesthesia. By decreasing the dose of dexmedetomidine we can prevent the side effects of dexmedetomidine (bradycardia, hypotension) as well as improve the quality of postoperative analgesia. However, its use needs to be explained in larger study population by further research.

CONCLUSION: To conclude, addition of dexmedetomidine (1µg/kg) to 0.5% isobaric levobupivacaine for axillary brachial plexus block shortens the onset time of sensory and motor block and prolongs their duration of action and increases the duration of postoperative analgesia.

REFERENCES:

1. Ashish R. Satapathy and David M. Coventry, Hindawi Publishing Corporation, Anesthesiology Research and Practice Volume 2011, Article ID 173796, 5 pages.
2. Foster RH, Markham A. Levobupivacaine: a review of its pharmacology and use as a local anaesthetic. *Drugs*. 2000; 59:551–79.
3. Elliott S, Eckersall S, Fligelstone L. Does addition of clonidine affect duration of analgesia of Bupivacaine in inguinal hernia repair. *Br J Anaesth* 1997; 79:446-9.
4. Singelyn FJ, Gouveineur J, Robert A. A minimum dose of clonidine added to mepivacaine prolongs duration analgesia after brachial plexus block. *Anesth Analg* 1996; 83:1046-50.
5. Popping DM, Elia N, Marret E, Wenk M, Tramèr MR. Clonidine as an adjuvant to local anaesthetic for peripheral nerve and plexus blocks: A meta-analysis of randomized trials. *Anesthesiology* 2009; 111:406-15.
6. Kanazi GE, Aouad MT, Jabbour-KHoury SI, Al Jazzar MD, Alameddine MM, Al-Yaman R et al. Effect of low-dose dexmedetomidine or clonidine on the characteristics of bupivacaine spinal block. *Acta Anaesth Scand*. 2006; 50:222– 27.
7. Memis D, Turan A, Karamanlioglu B, Pamukcu Z, Kyrt I. Adding dexmedetomidine to lidocaine for intravenous regional anesthesia. *Anesth Analg*. 2004; 98:835–40.
8. Esmaoglu A, Mizrak A, Akin A, Turk Y, Boyaci A. Addition of dexmedetomidine to lidocaine for intravenous regional anaesthesia. *Eur J Anaesthesiol*. 2005; 22:447–51.
9. Abosedira MA. Adding clonidine or dexmedetomidine to lidocaine during Bier's block: a comparative study. *J M Sci*. 2008; 8:660–64.
10. Esmaoglu A, Yegenoglu F, Akin A, Turk CY. Dexmedetomidine added to levobupivacaine prolongs axillary brachial plexus block. *Anesth Analg*. 2010; 111:1548–51.

ORIGINAL ARTICLE

11. Kaygusuz K, Kol IO, Duger C, Gursoy S, Ozturk H, Kayacan U et al. Effects of Adding Dexmedetomidine to Levobupivacaine in Axillary Brachial Plexus Block. *Current Therapeutic Research*, June 2012(Vol. 73, Issue 3, Pages 103-111).
12. Eisenach JC, De Kock M, Klimscha W. Alpha (2)- adrenergic agonists for regional anaesthesia. A clinical review of clonidine (1984-1995). *Anesthesiology* 1996; 85: 655-74.
13. Guo TZ, Jiang JY, Buttermann AE, Maze M. Dexmedetomidine injection into the locus coeruleus produces antinociception. *Anesthesiology* 1996; 84: 873-81.
14. Singelyn FJ, Gouverneur JM, Robert A. A minimum dose of clonidine added to mepivacaine prolongs the duration of anesthesia and analgesia after axillary brachial plexus block. *Anesth Analg.* 1996; 83:1046-50.
15. Singelyn FJ, Dangoisse M, Bartholomee S, Gouverneur JM. Adding clonidine to mepivacaine prolongs the duration of anesthesia and analgesia after brachial plexus block. *Reg Anesth.* 1992; 17: 148 -150.
16. Gaumann DM, Forster A, Griessen M, et al. Comparison between clonidine and epinephrine admixture to lidocaine in brachial plexus block. *Anesth Analg.* 1992; 75:69-74.
17. Sia S, Lepri A. Clonidine administered as an axillary block does not affect postoperative pain when given as the sole analgesic. *Anesth Analg.* 1999; 88:1109-12.
18. Erlacher W, Schuschnig C, Orlicek F, et al. The effects of clonidine on ropivacaine 0.75% in axillary perivascular brachial plexus block. *Acta Anaesthesiol Scand.* 2000; 44:53-57.
19. Culebras X, Van Gessel E, Hoffmeyer P, Gamulin Z. Clonidine combined with a long acting local anesthetic does not prolong postoperative analgesia after brachial plexus block but does induce hemodynamic changes. *Anesth Analg.* 2001; 92:199-204.
20. Duma A, Urbanek B, Sitzwohl C, Kreiger A, Zimpfer M, Kapral S. Clonidine as an adjuvant to local anaesthetic axillary brachial plexus block: a randomized, controlled study. *Br J Anaesth.* 2005; 94:112-16.

AUTHORS:

1. Karthik Anandh V.
2. J. P. S. Bhupal
3. Tejinderpal Kaur Grewal
4. Tripat Kaur Bindra
5. Rajan Verma

PARTICULARS OF CONTRIBUTORS:

1. Junior Resident, Department of Anaesthesiology, Government Medical College, Patiala.
2. Professor & HOD, Department of Anaesthesiology, Government Medical College, Patiala.
3. Associate Professor, Department of Anaesthesiology, Government Medical College, Patiala.

4. Associate Professor, Department of Anaesthesiology, Government Medical College, Patiala.
5. Assistant Professor, Department of Anaesthesiology, Government Medical College, Patiala.

NAME ADDRESS EMAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Karthik Anandh V,
Room No. 88, P. G. Doctors Hostel,
Rajindra Hospital, Patiala-147001.
E-mail: vkarthikanandh@gmail.com

Date of Submission: 16/12/2014.
Date of Peer Review: 17/12/2014.
Date of Acceptance: 09/01/2015.
Date of Publishing: 17/01/2015.